

8/16/2022 Mass Timber Task Force (Open Session)

Additional Materials for item "F.1) Presentation: David Barber, Overview of Performance-Based Fires Safety Design and Aspects Specific to Mass Timber"

Mass Timber: Performance Based Fire Safety Design Frameworks

David Barber

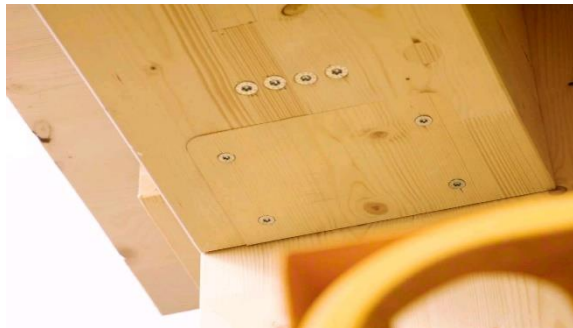


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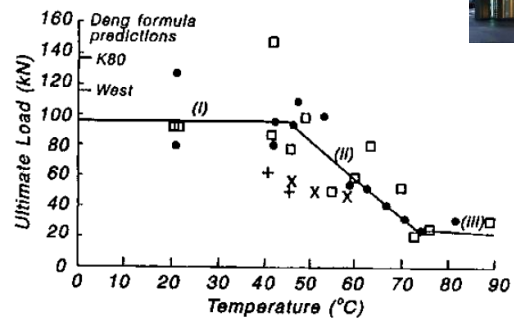


Introduction

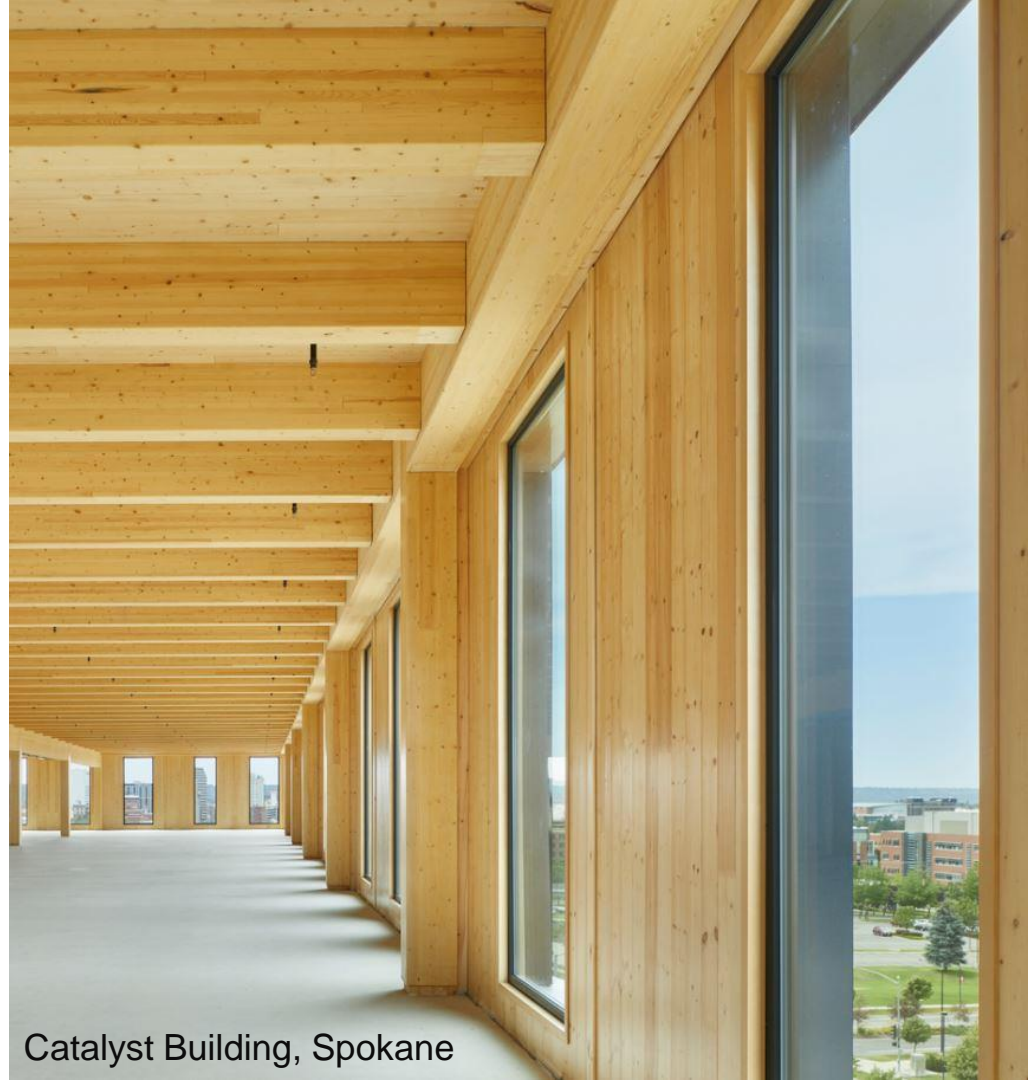
- What is being built?
- Performance based design
- Relevance to mass timber
- Framework approaches
- Questions and discussion



Who am I?



Mass timber - What is being built?



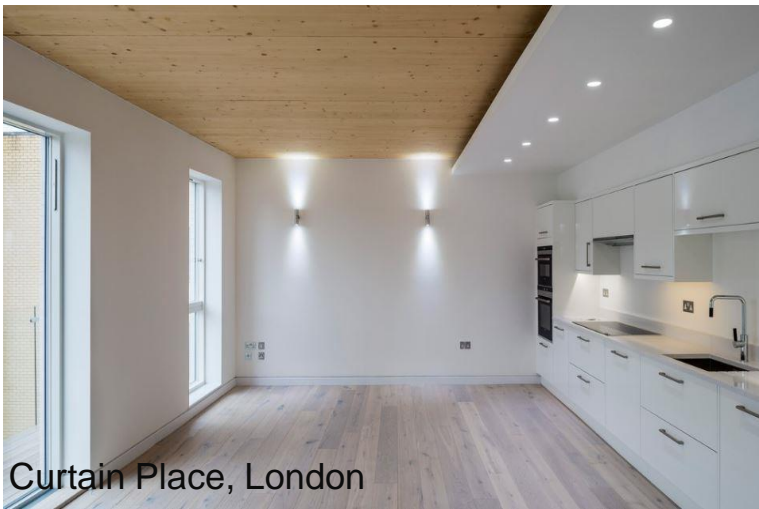
Catalyst Building, Spokane



Forte, Melbourne



Patch 22, Netherlands



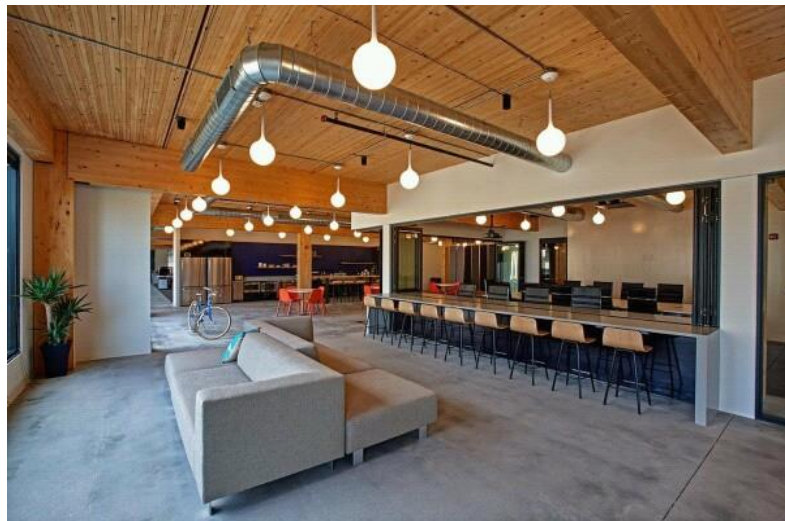
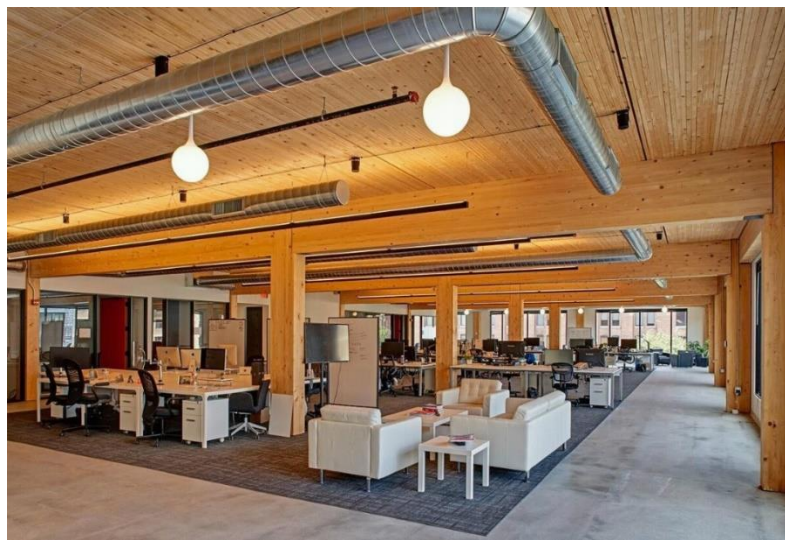
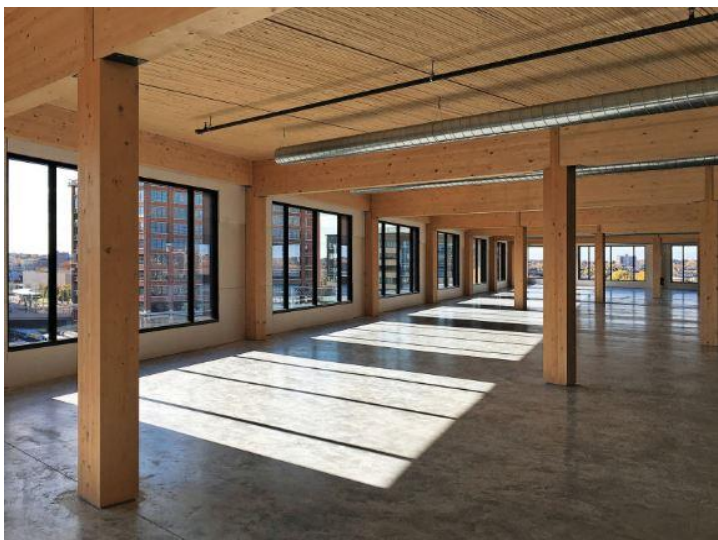
Curtain Place, London



Life Cycle Tower, Austria



Albina Yards, Portland



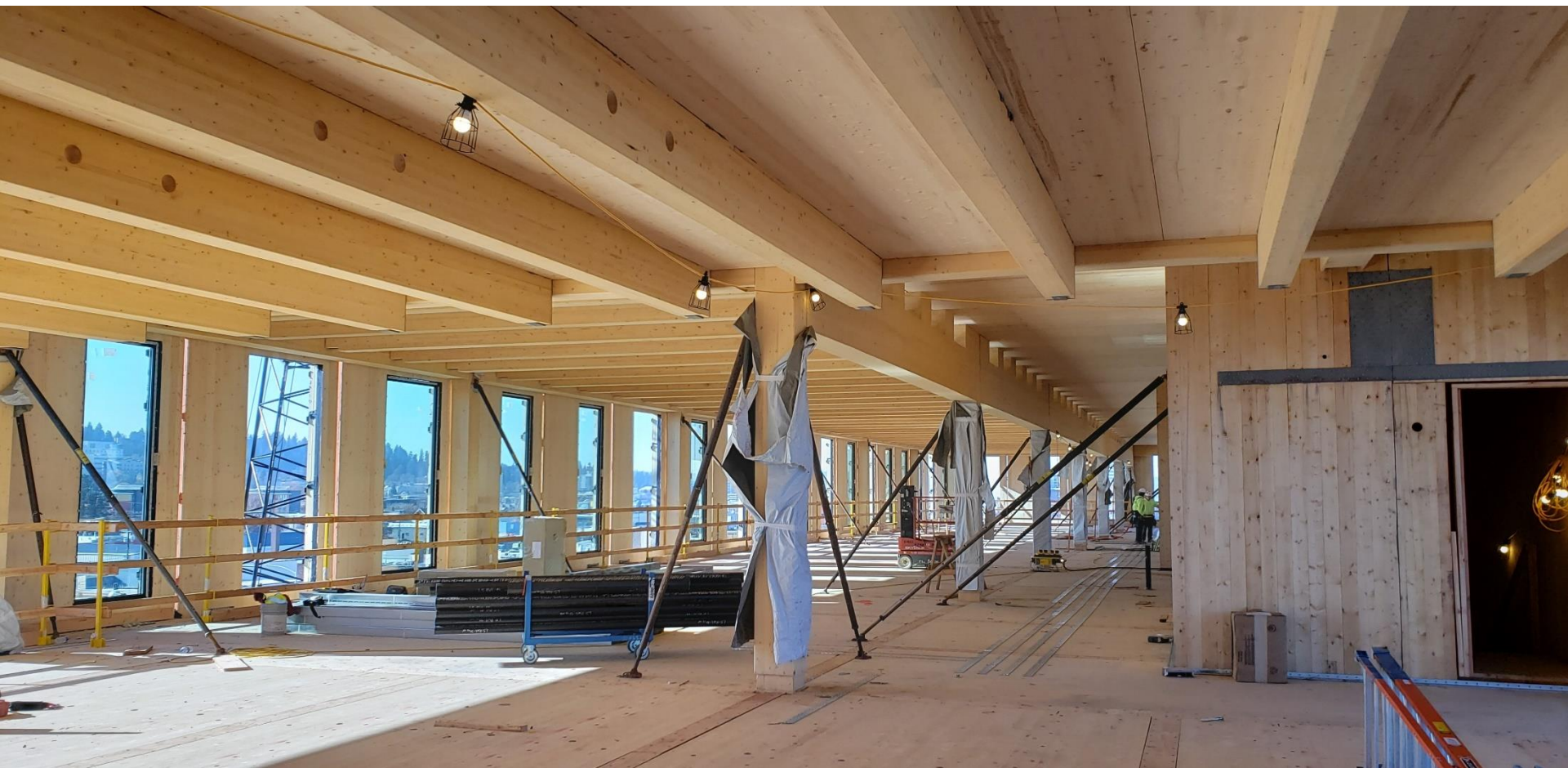
T3, Minneapolis



Carbon 12, Portland



First Tech, Portland



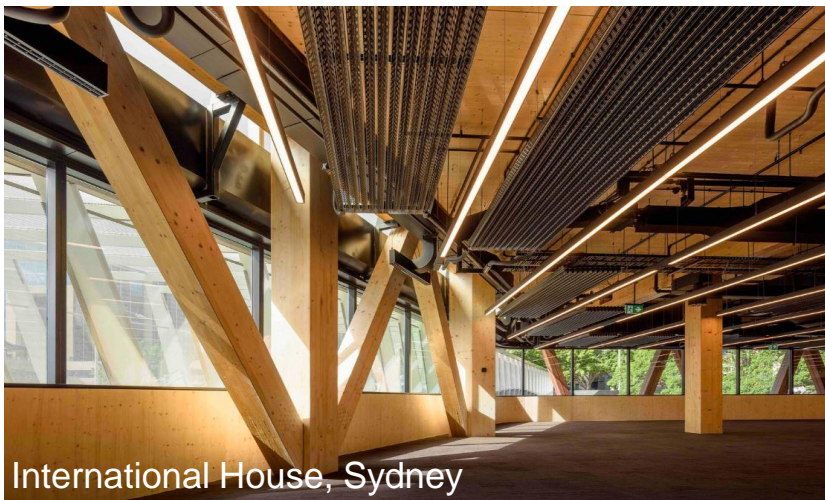
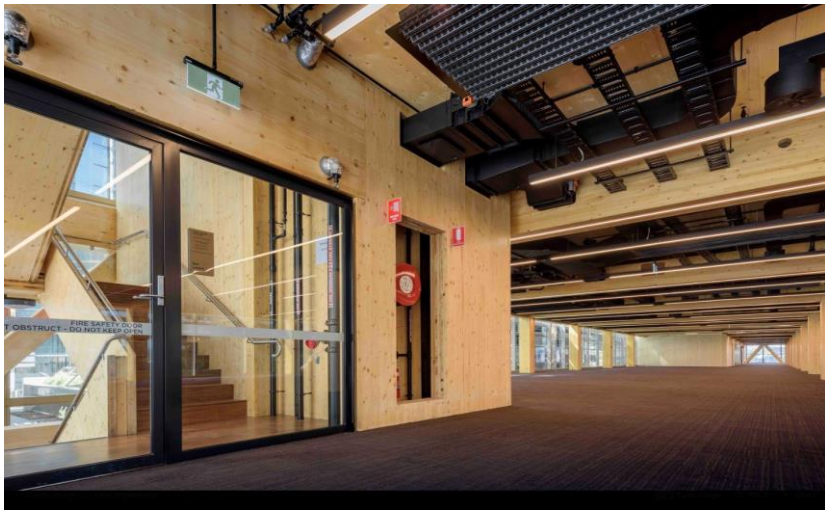
Catalyst Building, Spokane



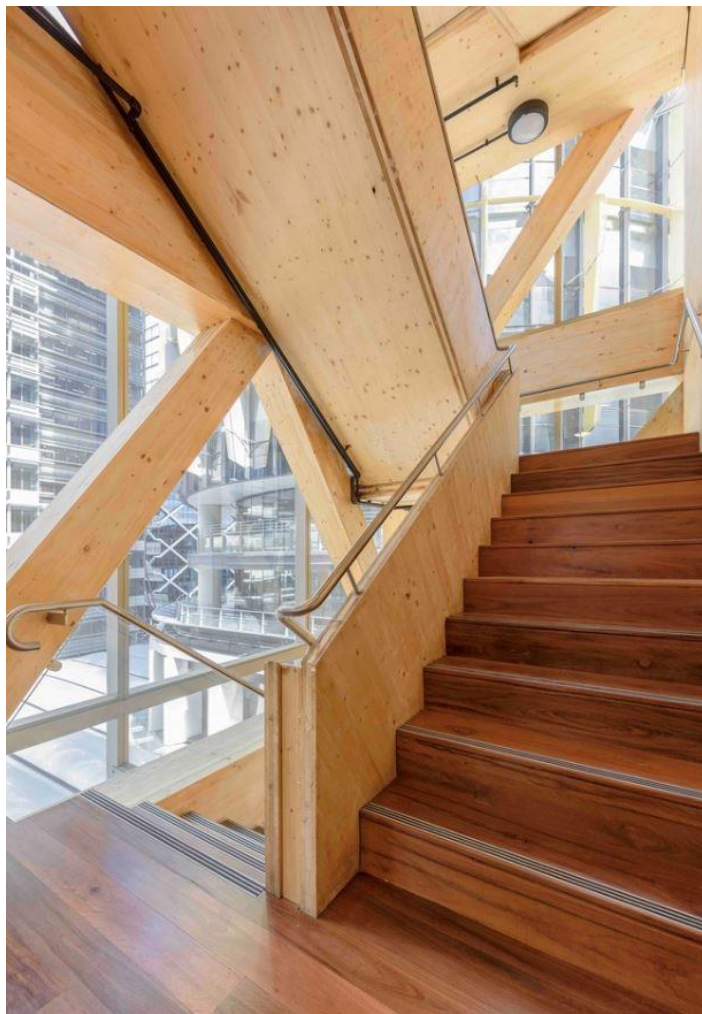
Apex Clean Energy HQ, Charlottesville



B Sky B, London



International House, Sydney





Forte, Melbourne



Murray Grove, London



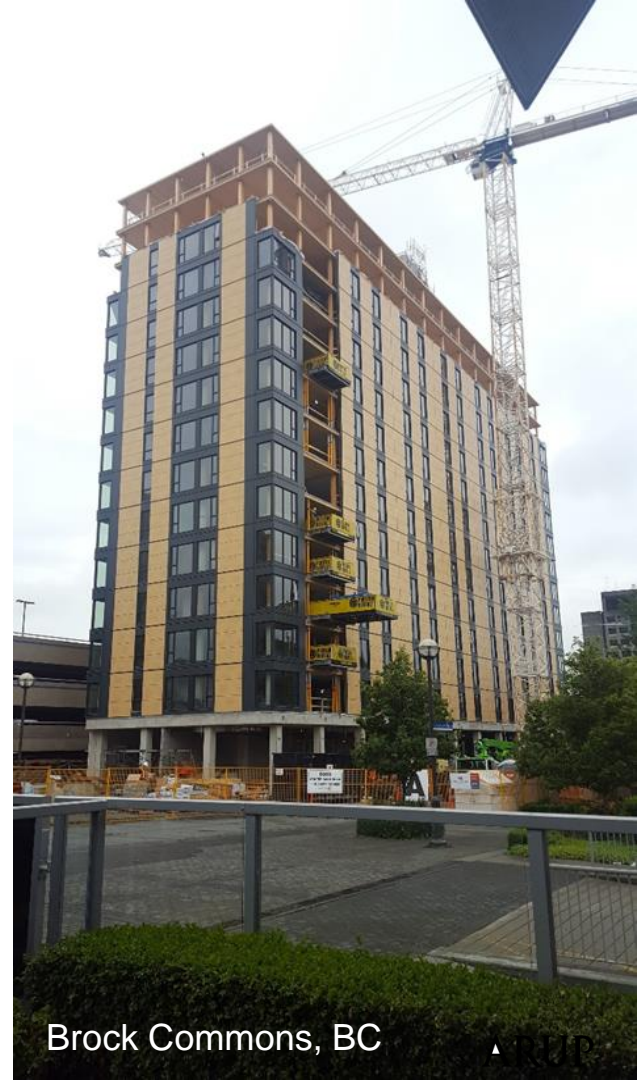
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Treet, Norway



Origine, Quebec



Brock Commons, BC



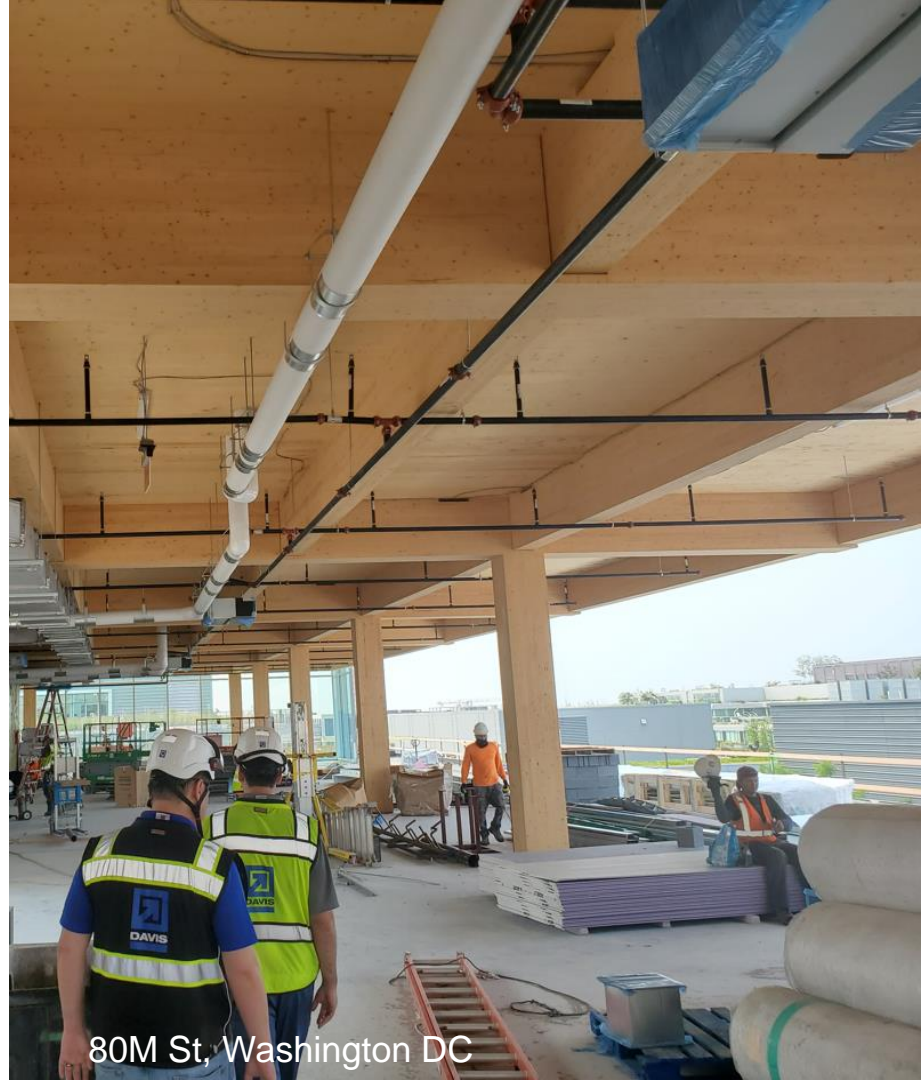
Mjøstårnet, Norway



Haut, Amsterdam



HoHo, Vienna



80M St, Washington DC

Ascent Tower



August 11, 2022 12:02 PM

What is performance based design?

- Prescriptive design is meeting the required code or standard
- Performance based design is proving by assessment and / or testing that a solution that varies from a code or standard meets pre-determined objectives
- ICC definition: *An engineering approach to design elements of a building based on agreed upon performance goals and objectives, engineering analysis and quantitative assessment of alternatives against the design goals and objectives using accepted engineering tools, methodologies and performance criteria*

What is performance based design?

Variance; code modification; administrative modification; alternative materials, designs and methods of construction

The stakeholders involved need to agree on:

- Code or standard non-compliance(s)
- Process for submission
- Pass or fail criteria
- Methodology of assessment or testing
- Inputs, limitations and assumptions
- Documentation and stages
- Reviews, when and by whom?



What is performance based design?

What is acceptable performance?

Prescriptive: *Temperature > 1,000°F at 10' above the top of the window opening, measured by thermocouples*

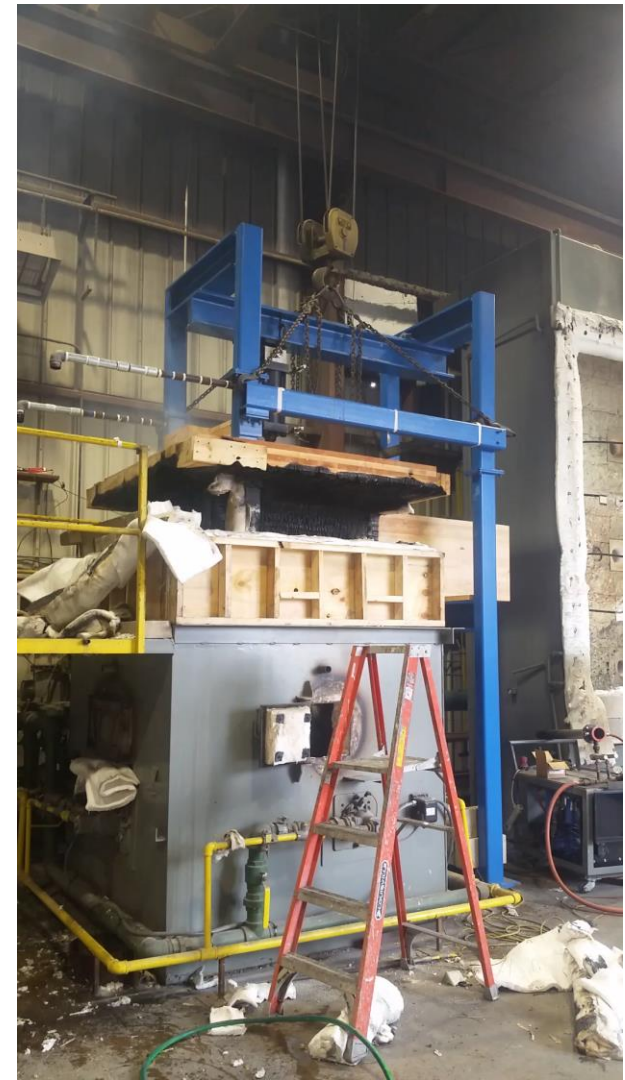
Performance based:

- Testing to meet agreed criteria
- Assessment of equivalence (comparative assessment)
- Absolute performance (pass / fail based on agreed values)
- Risk based assessment (ALARP or return period or value or loss)



Mass timber PB design examples

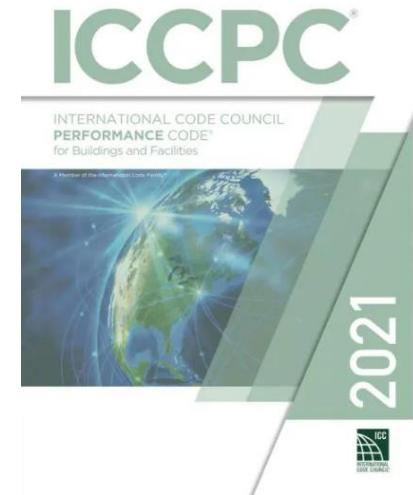
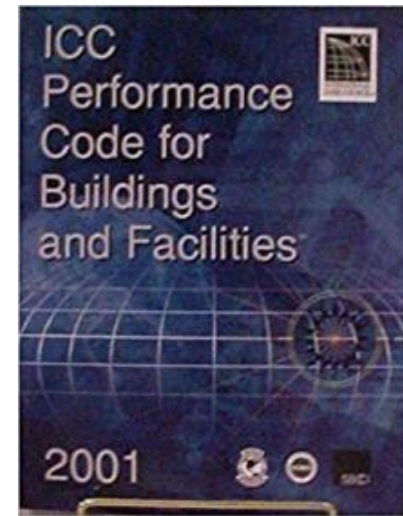
- Use of CLT (where 2015 IBC not adopted)
- Use of American Wood Council's TR-10
- Building height
- Fire resistance of glulam connections
- Use of a Canadian fire test report to Canadian standard
- Exposed mass timber structure area
- Combustible concealed spaces
- CLT floor located within an exterior wall
- MEP penetrations in glulam beams
- Steel column to glulam beam connections



Frameworks (PB processes and guides)

ICC Performance Code for Buildings and Facilities

- Performance code to address all building hazards
- Long history of development and use
- Very comprehensively written
- Not widely adopted (or used)
- Not easy to follow if new to PB design
- ICC can provide training on use
- PB design for fire safety would use about one third of the code



Frameworks (PB processes and guides)

ICC Performance Code for Buildings and Facilities

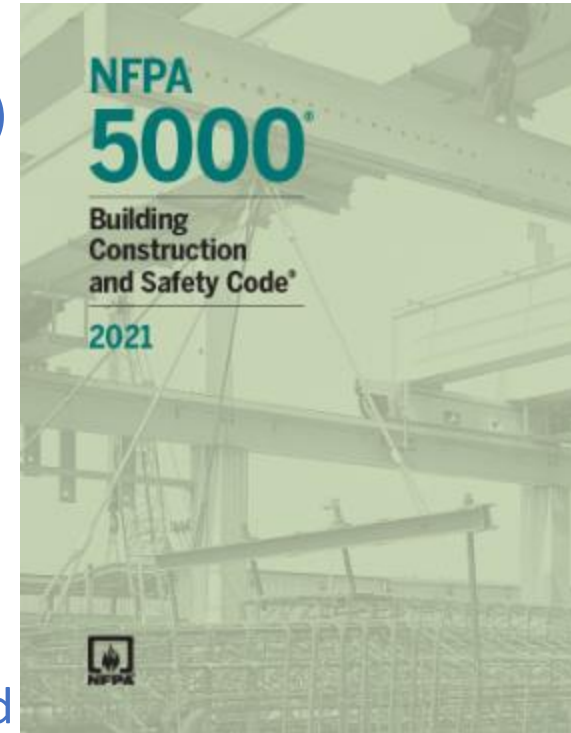
- Framework Building (Portland OR)
- Ascent Tower (Milwaukee)
- Many non-timber projects (casino's, airport terminals, convention centers etc)



Frameworks (PB processes and guides)

NFPA 5000 Building Construction and Safety Code (2021)

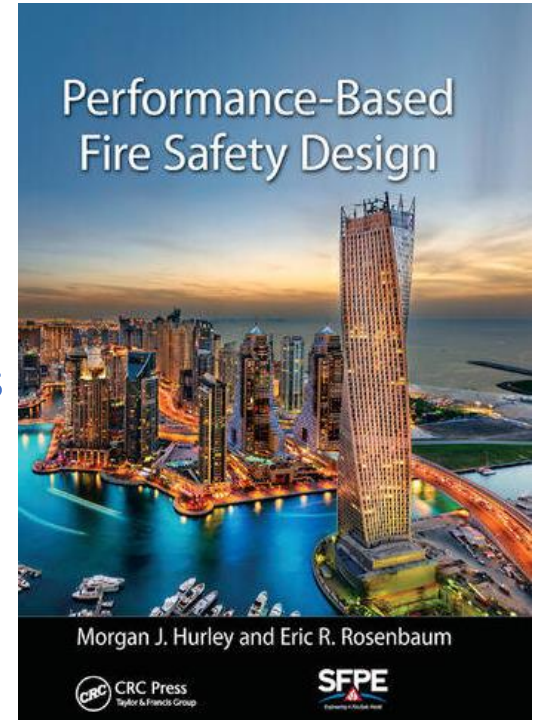
- NFPA's building code
- Allows for performance based design and provides framework to do so
- Not widely adopted in the US
- Includes mass timber construction and detailed section for fire safety alternatives
- NFPA provide training on use (not mass timber related)
- NFPA 101 "Life Safety Code" also allows a PB option and is more widely adopted



Frameworks (PB processes and guides)

SFPE Guide to Performance-Based Fire Safety Design

- Society of Fire Protection Engineers guidance
- Targeted at fire safety issues
- SFPE guides are used widely by fire protection engineers in the US
- Relatively easy to use
- SFPE also has a reviewers guide (“Code Official's Guide to Performance-Based Design Review”)
- SFPE provides regular training on use (not related to structures or timber)



Frameworks (PB processes and guides)

Other relevant examples

- ASCE Standard 7: *Minimum Design Loads for Buildings and Other Structures* (Appendix E on PB design for fires)
- FEMA P-58, *Development of Next Generation Performance-Based Seismic Design Procedures for New and Existing Buildings*
- Canadian mass timber guides
- UK Guidance PD7974 *Fire Safety Engineering. Application of fire safety engineering principles to the design of buildings*
- ISO Guidance ISO 23932 *Fire safety engineering — General principles* and ISO 13387 *Fire Safety Engineering*

Low, medium and high-rise buildings

Low and medium rise buildings (all materials):

- Designed to allow for evacuation, no spread to neighbouring buildings and allowing for firefighting intervention
- Structure does not need to withstand the full duration of the fully developed fire

High-rise buildings:

- Designed to a much higher standard of fire safety
- Evacuation and firefighting is much more difficult
- Structure needs to withstand the full duration of the fully developed fire



Some conclusions

Mass timber is an enabler of sustainable construction

Performance based design regularly occurs in engineering

Performance based design has many different names, methods of submission and approaches to review

ICC, NFPA, ASCE 7, SFPE - all provide good methods

The framework chosen will require training on use, WI specific guidance on use and suitable reviewers



A photograph of a construction site showing two workers in safety gear (hard hats and high-visibility vests) positioned on a large, light-colored wooden beam. The beam is being hoisted by a crane using yellow lifting straps. The background is a clear blue sky. The workers are looking towards the camera. The wooden structure is part of a larger framework, with other beams visible. The scene is brightly lit, suggesting a sunny day.

Thanks

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